

Serial No. 668,585
Filing Date 20 June 1996
Inventor Victor J. Marolda

NOTICE

The above identified patent application is available for licensing. Requests for information should be addressed to:

OFFICE OF NAVAL RESEARCH
DEPARTMENT OF THE NAVY
CODE OOCC3
ARLINGTON VA 22217-5660

DATA QUALITY INSPECTED

19970115 075

1 Navy Case No. 76633

2
3 FITTING FOR FLEXIBLE FUEL BLADDER

4
5 STATEMENT OF GOVERNMENT INTEREST

6 The invention described herein may be manufactured and used
7 by or for the Government of the United States of America for
8 governmental purposes without the payment of any royalties
9 thereon or therefor.

10
11 BACKGROUND OF THE INVENTION

12 (1) Field of the Invention

13 The present invention relates to fuel cells and containers,
14 and, more particularly, to fuel bladders for use in underwater
15 environment.

16 (2) Description of the Prior Art

17 Various arrangements have been suggested for fuel cells and
18 other smaller scale fuel containers. United States Patent No.
19 2,736,356 to Bender, et al. discloses a bladder-type fuel cell
20 having a fuel inlet, a fuel outlet and a pressure air inlet-
21 outlet. One side of the liquid cell collapses against the other
22 side of the liquid cell by expansion of the pressure cell to
23 expel the liquid.

24 United States Patent No. 2,727,656 to Clifton discloses an
25 aircraft auxiliary fuel cell which is collapsible by means of a

1 single manifold through which a tank is filled or emptied as
2 controlled by valves.

3 United States Patent No. 5,154,213 to Malomas et al.
4 discloses a fuel line adapter for portable fuel containers. The
5 fuel container has an outlet/inlet and an annular cap to be
6 received on the inlet. The cap has a shoulder around the upper
7 surface to overlap the inlet/outlet and the adapter is comprised
8 of a flange to be trapped between the outlet/inlet and the cap.
9 A pipe mounting on the adapter allows a pipe to extend from the
10 adapter.

11 Fuel bladders with flexible walls which enclosed a fuel
12 containing cavity and which has a fuel outlet superimposed over
13 an aperture in the flexible wall are used for marine use. Such
14 fuel bladders are manufactured, for example, by Imtra Corporation
15 of Clearwater, Florida and Annapolis, Maryland as shown in a
16 number of their advertising brochures. In such bladders a vinyl
17 hose tubular fuel outlet is inserted in the flexible bladder wall
18 through an aperture in the bladder wall and is fixed to the
19 bladder by a rubber seal and by a washer and nut combination
20 which are coaxially positioned on the tubular outlet.

21 One drawback to such surface use prior art marine fuel cells
22 is that the material of the vinyl-hose fittings may take a "cold
23 set", so when a screw cap is installed or removed, torque effects
24 tend to loosen the hose/fitting seal. It has been found that
25 several iterations of normal use (in underwater application)

1 produced a dramatic breakdown of the hermetic barrier even on new
2 bladders.

3 A second problem with the prior art marine fuel bladder is
4 that the method of securing the bladder to the penetration body
5 of the supply line and the fill tube is a protruding ring molded
6 into a plastic washer. When a nut is screwed down to press the
7 washer down onto the bladder the molded ring presses the bladder
8 into a corresponding circular groove in the penetration body.
9 This arrangement may be subject to leakage under the high
10 pressure at depth. It also may not stand up to rough handling.

11 A third problem is that the prior art marine bladder fill
12 system uses a screw-on cap having a flat gasket. Rough handling
13 may cause the cap to partially unscrew. As little as one-eighth
14 back turn of the cap can cause a significant fuel leak.

15 A fourth problem is that the typical single O-ring provides
16 a poor seal when there is no pressure difference to maintain a
17 tight fitting between the O-ring and its seat.

18 There is, therefore, a need for a durable, leak-proof, fill
19 system for a flexible fuel bladder suitable for use in an
20 underwater (high pressure) environment. There is also a need for
21 fittings for filling the bladder, for air-purge, and for delivery
22 of fuel to an engine underwater without loss of fuel or
23 contamination of fuel by water.

SUMMARY OF THE INVENTION

Accordingly, it is a general purpose and object of the present invention to provide a flexible fuel bladder for underwater operation which prevents loosening of the hose/fitting seal under normal use. It is a second object of the present invention to provide a method of securing the bladder to the penetration body to prevent leakage of fuel at the high pressures experienced at depth. A further object is to provide a fill system which prevents leakage caused by small back-turns of the fill cap. A still further object is to provide a tight o-ring seal in a flexible fuel bladder subject to high pressures.

These objects are accomplished with the fuel bladder of the present invention wherein there is a flexible bladder wall with a fuel outlet aperture. A tubular penetration body extends through the aperture and an interior flange on the tubular penetration abuts the interior side of the flexible bladder wall. A tubular valve connection member is superimposed over the fuel outlet aperture such that its outer peripheral surface abuts the inner peripheral surface of the tubular penetration body. A washer and a lock nut are positioned over the tubular penetration member to press the fuel bladder wall against the tubular penetration member interior flange. O-ring seals are provided on either side of the bladder wall. The tubular valve connection member connects to a valve which controls fuel flow through a supply hose which may be equipped with a manual pump. The fuel bladder is also equipped with an inlet valve.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more fully understood when the following description is read in light of the accompanying drawings in which:

FIG. 1 is a perspective view of a fuel bladder representing a preferred embodiment of the present invention;

FIG. 2 is an enlarged partially cross sectional view of the fuel supply valve and surrounding structure as taken through line 2-2 in FIG. 1; and

FIG. 3 is an enlarged cross sectional view of the fuel supply valve and surrounding structure as taken through line 3-3 in FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1, 2 and 3, in the first preferred embodiment of the fuel bladder of the present invention, the bladder comprises a flexible bladder wall shown generally at numeral 10 having a top side 12 and a bottom side 14 and opposed folding lateral walls 16 and 18. There is also a handle 20. On the top side there is a fill/bleed valve shown generally at numeral 22 which is connected to a coupling nut 24 by means of lanyard 26. On the top side there is also a supply/shut-off valve shown generally at numeral 28 from which a plastic supply hose 30 extends first to a supply manual pump 32 and then to engine quick-disconnect plug 34 which is equipped with an engine line end plug 36 which is secured by means of lanyard 38. The

1 material from which the bladder wall is constructed is a
2 flexible, solvent resistant polymeric material and is preferably
3 a fuel resistant, fiber reinforced elastomer. Preferably the
4 overall capacity of the fuel bladder will be about 18 gallons
5 although those skilled in the art will appreciate that the fuel
6 bladder described herein will be adaptable to use with a wide
7 range of capacities. Referring particularly to FIG. 2, it will
8 be seen that the fuel bladder wall has an exterior side 40 and an
9 interior side 42 and an interior cavity shown generally at
10 numeral 44 for retaining a liquid fuel (not shown). In the
11 bladder wall there is also a fuel supply aperture generally at 46
12 having a peripheral edge 48 which extends through the bladder
13 wall from said exterior side to said interior side. An at least
14 partially exteriorly positioned tubular valve connection member
15 shown generally at numeral 50 has an outer peripheral surface 52
16 and an opposed inner peripheral surface 54 and is at least in
17 part superimposed in concentric relation over the fuel supply
18 aperture. A tubular penetration body shown generally at numeral
19 56 has an outer peripheral surface 58, an inner peripheral
20 surface 60 and an interior flange 62. The interior flange has a
21 distal surface 64 and proximate surface 66 and is positioned such
22 that outer peripheral surface 58 of the tubular penetration body
23 abuts peripheral edge 48 of the fuel supply aperture. Inner
24 peripheral surface 60 of tubular penetrating body 56 also abuts
25 outer peripheral surface 52 of the tubular valve connection
26 member 50. Means such as coupling nut 68, which is connected to

1 the tubular penetration body by screw threads 70 and is
2 superimposed over a ceramic/TEFLON RULON slip washer 72 and
3 locking/sealing washer 74, are also provided for pressing the
4 flexible bladder wall against the proximate surface of the
5 interior flange of the tubular penetration body. To further
6 assist in sealing the fuel bladder wall to the tubular
7 penetration body there is a circular concentric ridge 76 on the
8 lower side of the locking/sealing washer which presses a portion
9 of the fuel bladder wall into a concentric recess 78 in the
10 proximate side of the interior flange of the tubular penetration
11 body. To further assist in sealing the peripheral edge of the
12 aperture in the fuel bladder wall, O-rings 80 and 82 are provided
13 in recesses, respectively, in the locking/sealing washer and the
14 tubular penetration body on the exterior and interior sides of
15 the fuel bladder wall. O-rings 84 and 86 are also provided in
16 recesses in the tubular valve connection member between the outer
17 surface of that member and the inner surface of the tubular
18 penetration body. The tubular valve connection member and the
19 tubular penetration body are connected by screw threads 88. The
20 tubular penetration body and the tubular valve connection member
21 are superimposed over a screen assembly which is shown generally
22 at numeral 90. This screen assembly is comprised of a tubular
23 support 92 which engages a snap ring 94 on the tubular
24 penetration body and a circular screen 96 which is attached at
25 its peripheral edge to the tubular support. On the tubular
26 penetration body there is also a blockage prevention groove

1 98. The tubular valve connection member has an outer terminal
2 end 100 which it is connected to an exterior valve shown
3 generally at numeral 102. The valve includes a valve body 104
4 which is engaged on screw thread 106 by valve stem 108 which has
5 at its terminal end a valve knob 110. A valve body cap 112 is
6 superimposed over the valve body, and the valve is also equipped
7 with O-rings as at 114 and 116. Referring particularly to FIG.
8 3, the fill/bleed valve has a generally similar construction and
9 is comprised of a tubular penetration member 118 with an interior
10 flange 120. The coupling nut 24 superimposed over washers 122
11 and 124 presses the fuel bladder wall against the interior
12 flange. The plug body 126 and valve 128 are positioned inside
13 tubular penetration member 118 and are supported by valve support
14 130. Tubular penetration body 56, tubular valve connection
15 member 50 and valve 102 are suitable metallic material such as
16 naval brass, bronze or injection molded plastic.

17 It will be appreciated that a flexible fuel bladder has been
18 described which is suitable for use in an underwater or other
19 high pressure environment. It will also be appreciated that this
20 fuel bladder has fittings which are capable of facilitating
21 filling the bladder, air-purging and delivery of fuel to an
22 engine underwater without loss of fuel or contamination of fuel
23 by water. Further, it will be appreciated that the double o-ring
24 structure between the proximate surface of the tubular
25 penetration body and the interior side of the bladder wall and
26 between the outer peripheral surface of the tubular penetration

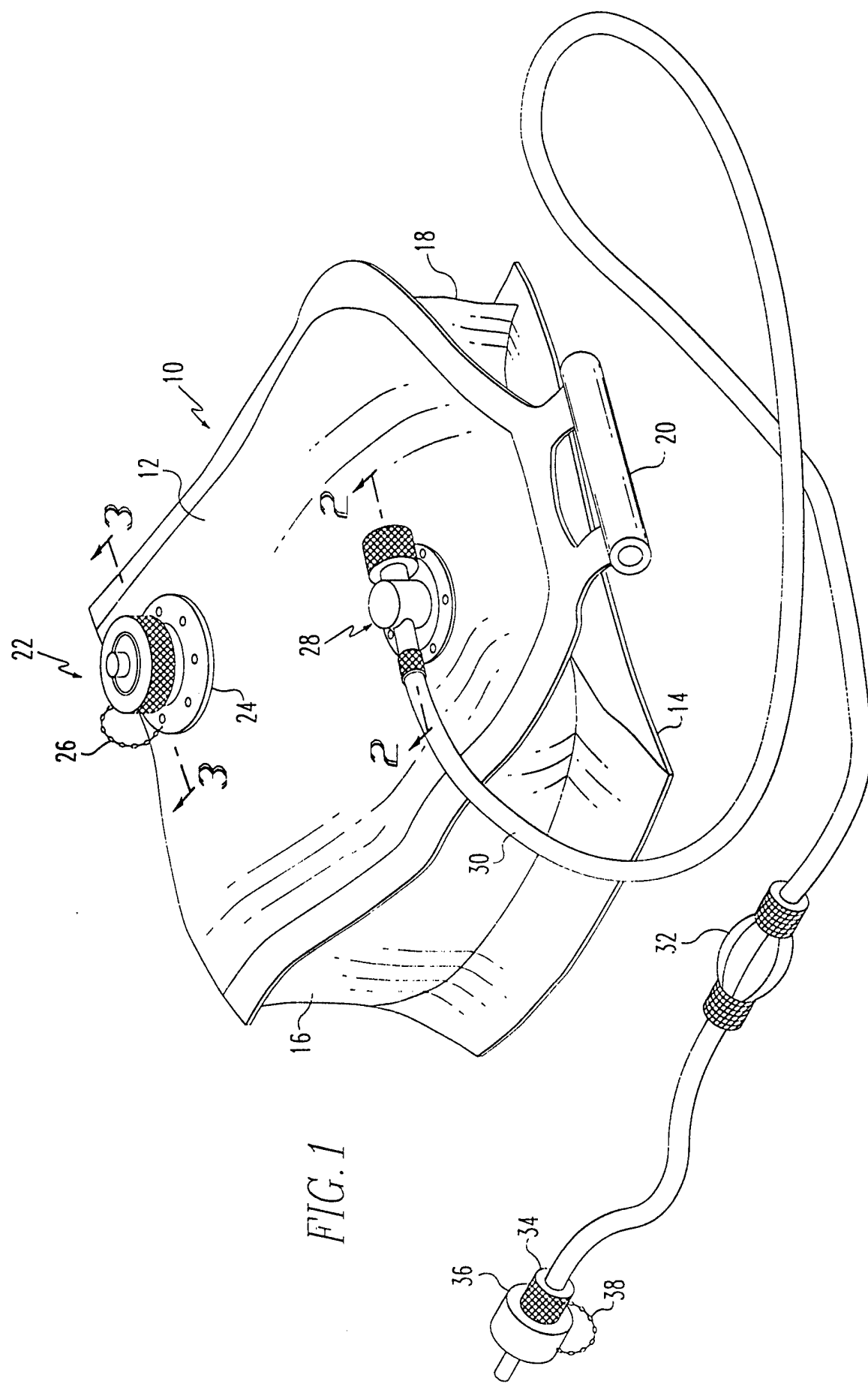
1 body and the exterior side of the bladder wall allows for a
2 particular efficient seal.

3 While the present invention has been described in connection
4 with the preferred embodiments of the various figures, it is to
5 be understood that other similar embodiments may be used or
6 modifications and additions may be made to the described
7 embodiment for performing the same function of the present
8 invention without deviating therefrom. For example, the
9 fill/bleed valve 22 and supply/shut-off valve 28 may be combined
10 into a single valve, thus eliminating one penetration through the
11 bladder wall. Such a combined valve might be connected to a hose
12 similar to supply hose 30 which would extend to a manual pump
13 similar to pump 32. Therefore, the present invention should not
14 be limited to any single embodiment
15
16

2
3 FITTING FOR FLEXIBLE FUEL BLADDER

4
5 ABSTRACT OF THE DISCLOSURE

6 Disclosed is a fuel bladder having a flexible bladder wall
7 with a fuel outlet aperture in which a tubular penetration body
8 extends through the aperture and an interior flange on the
9 tubular penetration abuts the interior side of the flexible
10 bladder wall. A tubular valve connection member is superimposed
11 over the fuel outlet aperture such that its outer peripheral
12 surface abuts the inner peripheral surface of the tubular
13 penetration body. A washer and a lock nut are positioned over
14 the tubular penetration member to press the fuel bladder wall
15 against the tubular penetration member interior flange. An O-
16 ring seal is positioned between the proximate surface of the
17 tubular penetration body and the interior side of the bladder
18 wall. Another O-ring seal is positioned adjacent the outer
19 peripheral surface of the tubular penetration body and the
20 exterior side of the bladder wall.



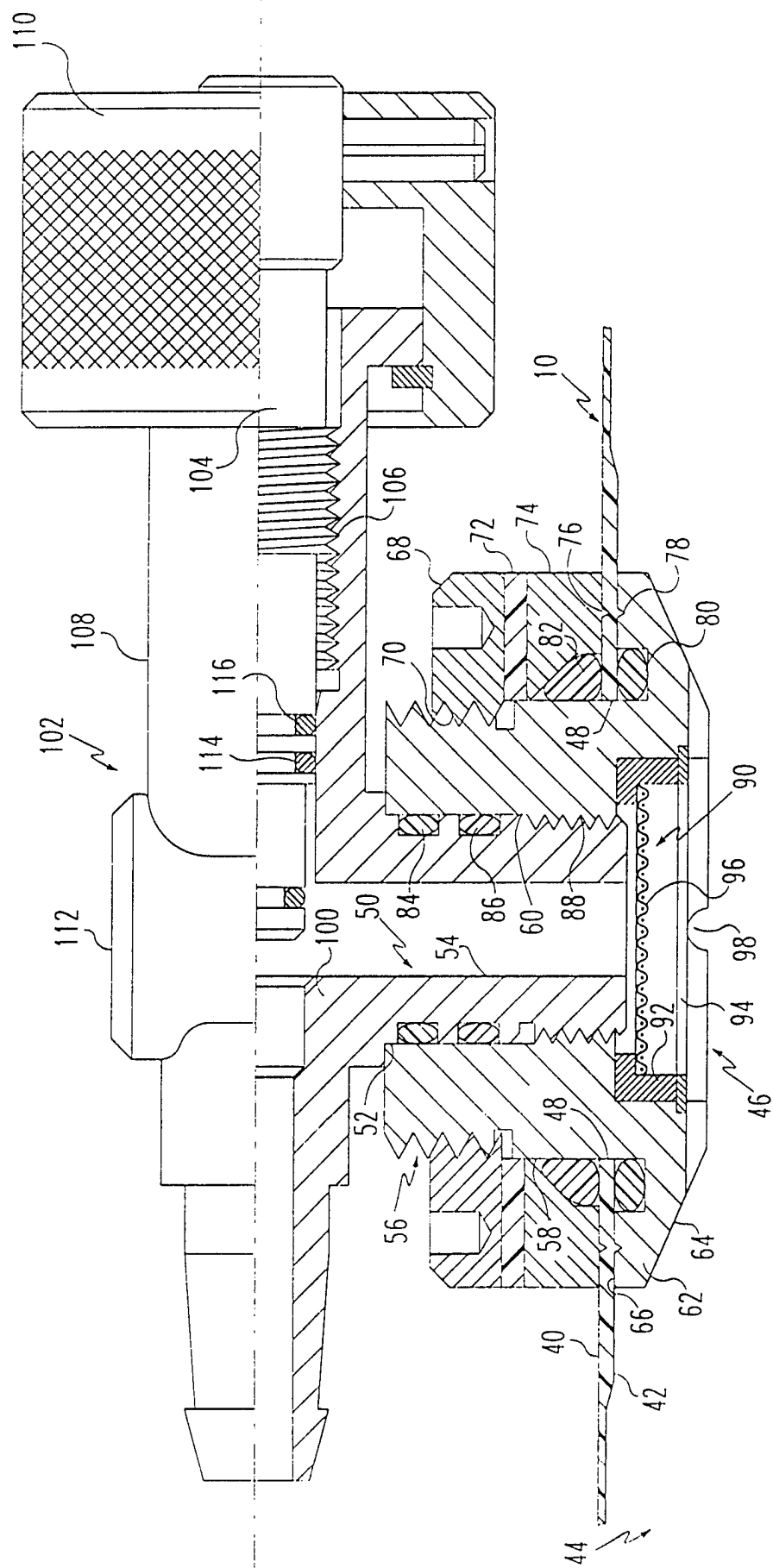


FIG. 2

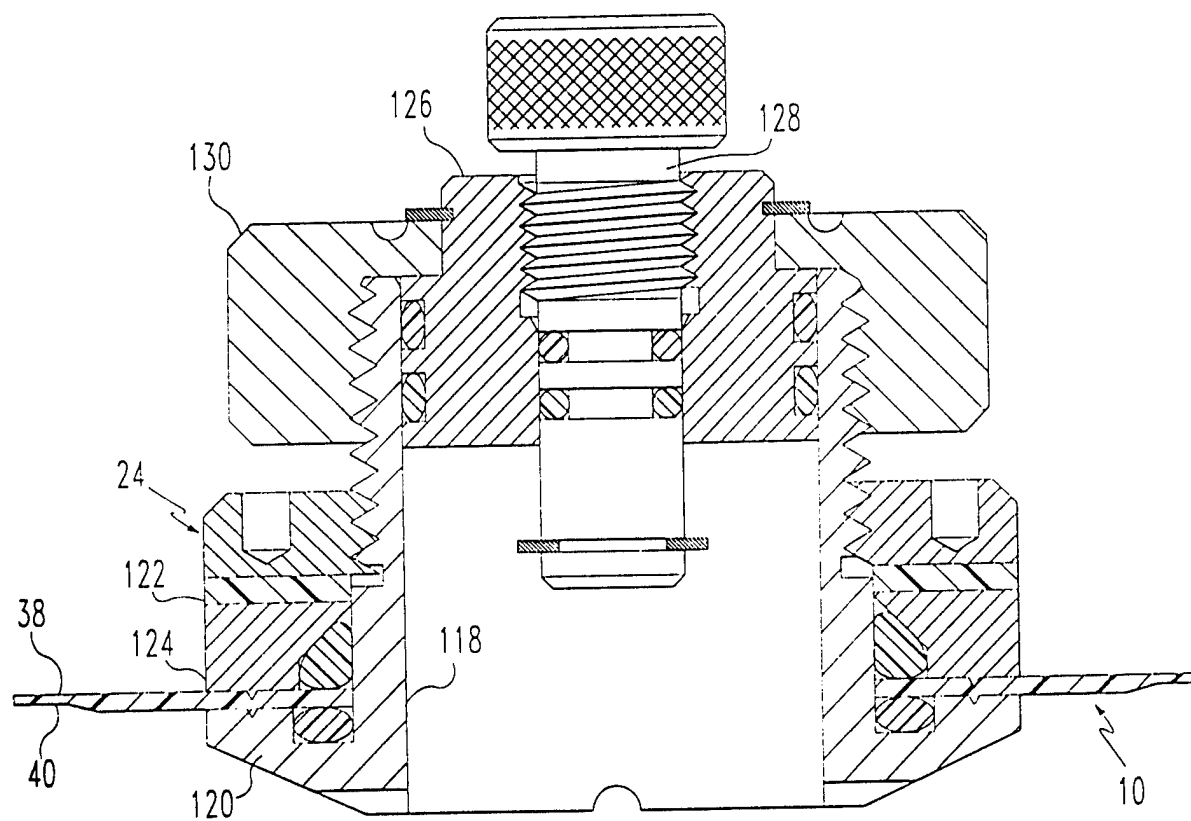


FIG. 3